

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS,
 INC.
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TC/TG/TRG MINUTES COVER SHEET

These minutes have been approved by unanimous vote by TC-4.2 at the annual ASHRAE meeting in Nashville, TN on 29 June 2004.

(Minutes of all meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/TRG No. TC 4.2 DATE: April 29, 2004

TC/TG/TRG TITLE: Weather Information

DATE OF MEETING: January 27, 2004 LOCATION: Anaheim, CA

MEMBERS PRESENT	MEMBERS ABSENT	EX/OFFICIO MEMBERS AND ADD'L ATTENDEES
Joe Huang (Chair) Chip Barnaby (Vice Chair) Larry Degelman (Secretary) Dru Crawley (Research, Stds) Marc Plantico (Handbook) Geoff Levermore (IM) Steve Cornick Jack Roberts Bill Bahnfleth (CM, Program) Don Colliver (CM, Webmaster) Achilles Karagiozis (CM) Hilda Snelling (CM) Tom Stoffel (CM)	Ken Hubbard Oscar Richard Gideon Rozen (IM) Bob Morris (CM, ALI Coord.) Henry Amistadi (CM) Reda Djebbar (CM) Don Hadley (CM) Linda Lawrie (CM) David Menicucci (CM) Richard Perez (CM) Ron Petersen (CM) Mike Squires (CM) David Wood (CM)	Eckhard Groll (TAC Sec Head) Nicholas Long Bill Fleming Moncef Krarti Didier Thevenard Charlie Whitlock Birol Kilkio Brian Rock

TAC CHAIR	Arthur McIvor
TAC SECTION HEAD	Eckhard Groll
RAC RESEARCH LIAISON	Michael Brandemuehl
HANDBOOK LIAISON	Bill Fleming
TEGA LIAISON	Charles Gullede III
ALI LIAISON	Doug Hittle
SPECIAL PUBLICATIONS LIAISON	Marilyn Listvan
PROGRAM LIAISON	Peter Simmonds
STAFF LIAISON (STANDARDS)	Claire Ramspeck
STAFF LIAISON (RESEARCH)	Mike Vaughn

Abbreviations: CM = Corresponding Member, IM = International Member

ASHRAE TC/TG/TRG ACTIVITIES SHEET

DATE: Current as of January 27, 2004.

TC/TG/TRG NO.: TC 4.2

TC/TG/TRG TITLE: Weather Information

CHAIR: Joe Huang

VICE CHAIR: Chip Barnaby

SECRETARY: Larry Degelman

TC/TG/TRG MEETING SCHEDULE			
Location-Past 12 Months	Date	Location-Planned Next 12 Months	Date
Anaheim CA	2004-01-27	Nashville, TN	2004-06-29
Kansas City MO	2003-07-01	Orlando, FL	2005-02-08
Chicago IL	2003-01-28	Denver, CO	2005-06-28

TC/TG/TRG SUBCOMMITTEES	
Function	Chairman
Handbook	Marc Plantico
Research & Standards	Drury Crawley

RESEARCH PROJECTS-CURRENT			
Project Title	Contractor	Monitoring Comm.	Report Made At Meeting
1171 RP - Sources of Uncertainty in the Calculation of Design Weather Conditions in the ASHRAE Handbook of Fundamentals	High Plains Regional Climate Center - University of Nebraska at Lincoln PI: Ken Hubbard	Robert Morris (chair) Dru Crawley Larry Degelman Marc Plantico	Yes, Final Draft.
1226 RP - Development of procedures to utilize Automated Surface Observing System (ASOS) weather data in building energy calculations	North Eastern Regional Climate Center – Cornell University PI: Art DeGataeno	Chip Barnaby (chair) Dru Crawley Joe Huang Robert Morris Marc Plantico	Yes
1273 RP - Update the Climatic Design Conditions in the ASHRAE 2005 HOF	Levelton Engineering	Dru Crawley (chair) Chip Barnaby Robert Morris Marc Plantico	Yes

LONG RANGE RESEARCH PLAN			
Rank Title	W/S Written	Approval	To R&T
1309-TRP, Development of a solar radiation model for tropical climates	Yes, Project let for bid.	At Kansas City	Sept. 2, 2003 Contractor to be chosen in Nashville.

HANDBOOK RESPONSIBILITIES					
Year	Volume	Chapter Title	No.	Deadline	Handbook Sub. Liaison
2005	HOF	Climatic Design Information	27	2004-06	Bill Fleming
STANDARDS ACTIVITIES – List and Describe Subjects					
TC 4.2 is the cognizant TC for SSPC 169P Weather Data for ASHRAE Building Standards. The TC 4.2 HOF data will be incorporated into this proposed standard. TC 4.2 may be involved in the development of new data different applications that may be required such as a “Design Moisture Year” for hygrothermal analysis of moisture in the building envelope. Other coordination will be undertaken as needed such as with SPC 160P.					
TECHNICAL PAPERS from Sponsored Research-Title, when presented (past 3 yrs. present & planned)					
<ul style="list-style-type: none"> • The Development of Typical Weather Years for International Locations (Parts 1 and 2), Honolulu June 2002 (1015-RP) • Web Access to Information on International Weather Data Sources, Honolulu June 2002 (1170-RP) • Sources of Uncertainty in the Design Weather Data in the ASHRAE Handbook, Nashville June 2004 (1171-RP) 					
TC/TG Sponsored Symposia-Title, when presented (past 3 yrs. present & planned)					
<ul style="list-style-type: none"> • Recent Developments in the Availability of International Weather Data – Symposium HI-02-16, Honolulu, June 2002. • Recent Research on Climate Uncertainty and Change –Denver CO, June 2005. 					
TC/TG Sponsored Seminars-Title when presented (past 3 yrs. present & planned)					
<ul style="list-style-type: none"> • Design Applications of Recent ASHRAE Weather Data - Seminar 27, Atlantic City, Jan, 2002. • Use of Weather Data for Building Design and Operation – Kansas City, June 2003. • New Weather Data for HOF 2005 – Seminar in Orlando FL, January 2005. • Solar Model Differences – Seminar in Orlando FL, January 2005. 					
TC/TG Sponsored Forums-Title, when presented (past 3 yrs. present & planned)					
<ul style="list-style-type: none"> • How Can Weather Data Be Made More Useful for ASHRAE Members? – Forum 24, Chicago, January 2003. 					
JOURNAL PUBLICATIONS, when published (past 3 yrs. present & planned)					
None					

Meeting Minutes
ASHRAE Technical Committee 4.2
Weather Information
Anaheim, CA, January 27, 2004

Call to Order, Roll Call, and Approval of Minutes (1:00 p.m.)

TC Chair Joe Huang called the meeting to order at 1:00 PM and roll call was taken. A quorum was established with 8 of 11 voting members initially present (see cover sheet).

The agenda is attached.

Approval of Kansas City Minutes

Motion by Dru Crawley to approve the minutes of the Kansas City meeting (July 1, 2003). 2nd by Steve Cornick. Approved 7-0-0 CNV.

Research –Dru Crawley (1:10 p.m.)

Dru Crawley reported on the Research Subcommittee meeting (minutes and agenda attached).

Active research projects. The status of active research projects sponsored by the TC is –

- 1171-RP (Sources of Uncertainty in the Calculation of Design Weather Conditions in the ASHRAE Handbook of Fundamentals). The contractor (Ken Hubbard) had submitted the final draft responding to the PMSC’s editorial comments and request for additional explanatory material in some sections. The final report had previously been approved in Kansas City contingent on receipt of the revised version.
- 1226-RP (Development of Procedures to Utilize Automated Surface Observing System “ASOS” Weather Data in Building Energy Calculations). Project is being finalized for completion date of March 30, 2004.
- 1273-RP (Update the Climatic Design Conditions in the ASHRAE HOF). The contractor P.I. (Didier Thevenard) presented a progress report on the expanded tables for the next HOF. A weather data viewer will be provided in Microsoft Excel to view data frequencies as well as other weather parameters.
- 1309-TRP (Development of Solar Radiation Models for Tropical Locations). Proposals for this research project are due at ASHRAE on May 15, 2004. The TC-4.2 committee will likely choose a contractor at the Nashville meeting, based on the Research subcommittee recommendation.

Research plan, RTARs. Several RTARs were presented and discussed – (1) Degelman on user-customized weather, (2) Levermore on TMY 2025, (3) Haberl on ground water temperatures, (4) one from TC-4.7 on generation of a typical wet-bulb year, (5) Huang on generated hourly values for non collected locations, and (6) Barnaby on weather data for design day calculations. The TC plans to propose a prioritized plan in Nashville.

Handbook – Marc Plantico (1:20 p.m.)

Marc Plantico reported on the Handbook Subcommittee Meeting. See attached report and agenda. He stated that the HOF (Chap 28) tables would be ready in March for review. There will be added information from chapter 29 on residential load calculations. TC-4.1 & TC-4.5 needs generated design load profiles for their examples. Information on clear sky data for radiation data for handbook will be

correlated with Ross Cluney as to specific content and format. Barnaby agreed to take lead on what requirements would be for radiation data and work with other committees. Levermore and Stoeffel agreed to assist him. Plantico asked for inputs on anything that members have info/changes for. Uncertainty data would be available from Hubbard's research project work. Chip agreed to obtain additional data from Art Quitano. Didier agreed to provide IWEC reference data.

[Section announcement]:

Craig Wray, section 4 head, announced that the section was happy with 4.2 works. Also that TC chairs and vice chairs are to begin to meet together early before the TC meetings start. A recent ASHRAE Forum revealed that the handbook does not need to be fixed. He also said that the TAC is here to help the TC's do their work better. Bill Fleming described what was derived from a survey about the handbook. Barnaby suggested an ASHRAE HVAC design procedure handbook.

Program – Bill Bahnfleth Chair (Chip Barnaby, vice chair, presented)

It was announced that TC-4.2 had no program items in Anaheim. Bill Bahnfleth is program head, who had conflicting activity on other matters. Chip Barnaby volunteered to take the program chair role as part of Vice Chair duties. Program ideas included: (1) a discussion on possibly having either a Forum or Seminar on Design Day weather data for Nashville, (2) climate change (Crawley and Levermore), (3) uncertainty data by Ken Hubbard (tech paper), (4) recent research on climate uncertainty and change (Bob Morris), and (5) comparison of different solar model predictions in different climates (Karti and Huang).

After committee discussions, a program plan was proposed to include the following:

Nashville 2004: None

Orlando (Winter 2005):

Seminar 1, Climatic Data Updates in the 2005 HOF.

1. Description of new tables and statistics for 2005 HOF (Thevenard)
2. Design day profile weather generator (Barnaby)
3. WDVView (Crawley)
4. Generation of design solar data (clear sky models) (Huang / Stoeffel).

Seminar 2, Evaluation of Solar models (Karti, chair)

Denver (Summer 2005):

Symposium: Recent research on climate uncertainty and change (Morris, chair).

Huang called for vote: Barnaby moved & Crawley 2nd. Approved 7-0-0 CNV.

Membership Roster – Bob Morris (Huang presented)

Huang reviewed the new TC roster that began on July 3, 2003.

Standards – Dru Crawley

SSPC 169P (Weather Data for Building Design Standards). Crawley reported that there has been no recent activity in 169P. He added that weather data to be used in ASHRAE standards is a slowly evolving issue.

Old Business

Huang presented information on the NASA weather and climate data initiative. Discussion ensued about what response should be made. NASA data could be included in HOF as a reference. Huang asked members to review the e-mail memo and share thoughts back to him. More information can be found at http://asd-www.larc.nasa.gov/new_AtSC/.

New Business

- (1) Crawley described an IEA task to generate methods for deriving solar radiation values from satellite data. Dave Renee at NREL is task leader. Richard Perez is also involved. There is a meeting on the topic in Madrid, Spain in 3 weeks (approx 18 Feb).
- (2) Huang described frequent appearances of questions on where to get weather data for various worldwide locations. Crawley volunteered to contact Mickey Geschwiler about publishing data for individual cities downloadable (for sale) from an ASHRAE web site.
- (3) Huang proposed the idea of TC-4.2 being a liaison to other worldwide sources of weather data for energy calculations. The idea is to obtain non-ASHRAE sources of weather data files and distribute for commission. Huang will check several sources to investigate willingness to cooperate in this.

Announcements:

- (1) CIB world meeting in Toronto, May 2-6, 2004, to talk about climate change issues.
- (2) CWEED and CWEC data are being distributed free.
- (3) Barnaby announced the IBPSA-USA simulation conference announcement to be held in Boulder CO in Aug 2004 and the worldwide IBPSA Building Simulation 2005 conference to be held in Montreal in August 2005.
- (4) Huang reported on seminar from TC-4.7 (Energy Calculations) Nashville seminar on what to do when weather data are misbehaving.

Adjournment at 3:30 p.m.

Next meeting: Tuesday, 1:00 p.m. June 29, 2004, Nashville TN.

**ASHRAE TC 4.2 Weather Information
Agenda for the 2004 Winter Meeting
Anaheim CA
Marriot/Los Angeles (Lower Level)
Tuesday, January 27, 2004
1:00 – 3:30 PM**

- 1:00 pm **Call to order and Roll Call** (Huang/Degelman)
1:10 pm **Introduction of liaison representatives from standing committees**
1:15 pm **Approval of minutes from Kansas City June 2003 meeting**

Subcommittee Reports:

- 1:20 pm **Research** (Crawley)

- **1171-RP** Sources of Uncertainty in the Calculation of Design Weather Conditions in the ASHRAE Handbook of Fundamentals
- **1226-RP** Development of Procedures to Utilize Automated Surface Observing System (ASOS) Weather Data in Building Energy Calculations
- **1273-RP** Update The Climatic Design Conditions In The ASHRAE Handbook of Fundamentals
- **1309-TRP** Development of a solar radiation model for tropical climates
- Other Work Statements under development

- 2:00 pm **Handbook** (Plantico)

- Status and Schedule for 2005 Weather Chapter
- New Chapter Outline for 2005 Weather Chapter

- 2:20 pm **Program** (Bahnfleth)

- 2:30 pm **Membership/Roster** (Huang)

- 2:35 pm **Standards** (Crawley)

- 2:40 pm **Old Business**

- NASA weather and climate data initiative

- 3:10 pm **New Business**

- Web download of ASHRAE weather data
- Should TC-4.2 be a liaison to international weather data sets for energy calculations?

- 3:25 pm **Announcements**

- 3:30 pm **Adjourn**

Next meeting: Nashville TN, June 29, 2004

Meeting Minutes
Research Subcommittee
ASHRAE TC 4.2 Weather Information
4:15-6:30 pm, Monday, January 26, 2004
Los Angeles, LL, Marriott
Anaheim, California

Present:

Dru Crawley, Subcommittee Chair	Moncef Krarti
J Patrick Carpenter	Geoff Levermore
Don Colliver	Marc Plantico
Steven Cornick	Jack Roberts
Larry Degelman	Gideon Rozen
Jeff Haberl	Hilda Snelling
Joe Huang	Tom Stoffel

Chair Crawley called the meeting to order at 4:15 pm. Those present introduced themselves. See attached agenda.

1171-RP Sources of Uncertainty in the Calculation of Design Weather Conditions in the ASHRAE Handbook of Fundamentals.

PMS Chair Morris was not able to come to Anaheim. The contractor has submitted a revised final draft report to the PMS. The PMS has yet to recommend whether the TC should recommend approval of the report to the TC.

1226-RP - Development of Procedures to Utilize Automated Surface Observing System (ASOS) Weather Data in Building Energy Calculations

PMS Chair Barnaby reported that the project is essentially complete with the contractor providing several draft versions of the report for review. Final review by the PMS should occur prior to the next meeting.

1273-RP Update the Climatic Design Conditions in the ASHRAE Handbook of Fundamentals

The PMS (and much of the TC) met with the contractor on Sunday in conjunction with the Handbook subcommittee. This project is nearly complete with a few issues that were resolved in Anaheim. The contractor expects to complete all the work and submit a draft report, draft technical paper, and tables prior to the Nashville meeting. See the joint minutes of 1273-RP and the Handbook Subcommittee for more details.

1309-TRP Development of a Solar Radiation Model for Tropical Climates

This work statement was approved by the TC at the Kansas City meeting, reviewed by the Research Administration Committee during the fall, and approved for bidding Spring 2004. We expect that bids will be reviewed by the Project Evaluation Subcommittee (PES) prior to the Nashville meeting. Chair Huang had appointed the following to the PES: Larry Degelman (Chair), Dru Crawley, Chip Barnaby, and Ken Hubbard.

Draft Work Statements/Research Topics

There was substantial discussion of various research topics and draft RTARs provided to the TC by members.

- Development of User-Customizable Weather Data Selection.
Larry Degelman circulated a draft RTAR on this topic to the TC (see attachment). Patrick Carpenter and Geoff Levermore agreed to work further on this for the next meeting.
- TMYs for 2025.
Geoff Levermore provided the TC with a draft RTAR titled “WYECs for 2025 (2050 and 2080)” prior to the last meeting (see attachment). Everyone agreed to provide comments to Geoff before the Nashville meeting.
- Ground Temperatures.
Jeff Haberl had sent a draft RTAR on the subject to the TC earlier in the spring (see attachment). Several people brought up questions that needed more explanation and several additional potential sources of data were identified. Jeff agreed to circulate a revised RTAR in the spring.
- Typical Moisture Year.
This is a topic being discussed in TC 4.4. We are monitoring progress.
- Generating hourly data for locations where its not recorded.
Joe Huang agreed to find the draft work statement developed on this topic a few years ago and circulate them to the TC. Given the availability of satellite data, this topic may be timely. Larry Degelman reminded the subcommittee of his weather generator program. Dru Crawley agreed to turn the work statement into a RTAR. TC members agreed to review the works statement and provide comments to Joe Huang before the Nashville meeting.
- Design Day Calculations.
Chip Barnaby brought up the topic of design day calculations as a potential research project. He agreed to bring further ideas to the Nashville meeting.
- TC 4.4.
Steve Cornick said that TC 4.4 had several they were developing which we should follow. He agreed to provide more information at the next meeting.

Research Plan 2004/2005

The prior TC 4.2 research plan for 2003/2004 included the Solar Radiation Model work statement that will be sent out for bids in Spring 2004. The TC will need to select up to two RTARs for the new research plan at the Nashville meeting.

The meeting was adjourned at 6:20 PM.

AGENDA
Research Subcommittee
ASHRAE TC 4.2 Weather Information
4:15-6:30 pm, Monday, January 26, 2004
Los Angeles, LL, Marriott
Anaheim, California

- 4:15 Call to order / changes to the agenda
Crawley
- 4:20 **1171-RP** Sources of Uncertainty in the Calculation of Design Weather Conditions in the ASHRAE Handbook of Fundamentals
Morris
- 4:30 **1226-RP** - Development of procedures to utilize Automated Surface Observing System (ASOS) weather data in building energy calculations
Barnaby
- 5:00 **1273-RP** Update The Climatic Design Conditions In The ASHRAE Handbook of Fundamentals

Crawley
- 5:40 **1309-TRP** Development of a solar radiation model for tropical climates
- 5:45 **Draft Work Statements/Research Topics**
- Development of User-Customizable Weather Data Selection
Degelman
 - TMYs for 2025
Levermore
 - Ground Temperatures
Haberl
 - Typical Moisture Year
TC 4.6
 - Generating hourly data for locations where its not recorded
Huang
 - Other new topics?
- 6:10 **Research Plan 2004 / 2005**
Crawley
- Development of a solar radiation model for tropical climates (on 2003/2004 plan)
 - Development of User-Customizable Weather Data Selection
 - Other RTARs (due to ASHRAE before August)
- 6:25 New Business
- 6:30 Adjourn

**RTAR (RESEARCH TOPIC ACCEPTANCE REQUEST)
TC 4.2 Weather Information**

Title: Development of User-Customizable Weather Data Selection

Research Category: Design and O&M Tools

Research Classification: Basic and Applied

TC/TC Priority: New

Estimated Cost: \$100,000

Other Interested TC/TGs: TC 4.7, TC 9.6, TC 6.8, TC 6.6

Possible Co-funding Organizations: NOAA, NWS, USDOE, USEPA

**Handbook Chapters to be Affected
By Results of this Project:** Chapter 27 Climate Design Information
Chapter 28 Residential Cooling & Heating Load Calculations
Chapter 29 Nonresidential Cooling & Heating Load Calculations
Chapter 31 Energy Estimating & Modeling Methods

Background / State-of-the-Art:

Whole-building, hourly thermal simulation programs are used by building designers for calculating peak heating/cooling loads and the annual energy performance of new buildings. Simulation programs are also used for other purposes, including the verification of the savings from retrofits installed in existing buildings, and for calculating the energy impact for building code requirements such as ASHRAE Standard 90.1, and 90.2. Such programs calculate the dynamic heat transfer through roofs, walls, windows and floors, as well as the energy used for heating domestic water. In most cases these programs use weather data files, such as the IWEC, CWEC, TMY2, WYEC2 and TRY2 formats, which have been extensively studied and developed from many years of data for a large number of locations in the U.S. and foreign countries. These files contain “typical” hourly data of dry-bulb temperature, humidity, solar radiation, wind speed, and other lesser used weather parameters.

Typical weather data, however, do not usually contain extreme design sequences or other design sequences for checking performance of a variety of HVAC equipment under various weather conditions. To further enhance the usefulness of weather data for designers, ASHRAE has funded the development of extreme hourly weather sequences for design purposes for 381 US and Canadian locations (Colliver 1998.) These extreme weather sequences allow a designer to test HVAC equipment designs under the worst conditions at a given site, conditions that do not exist in the typical weather data files. Lacking still is a method that designers can use to select a customized weather data sequence that will allow them to design/check equipment performance under varying outdoor conditions – from extreme temperature conditions to more moderate temperature conditions, from extreme humidity to moderate humidity conditions, and from extreme solar to moderate solar conditions.

Advancement to State-of-the-Art / Justification:

At this moment, designers are faced with choosing hourly weather data from either typical annualized files or from files that contain extreme temperature and humidity sequences. HVAC equipment being designed, however, does not respond in a uniform manner to the various weather parameters. Certain equipment needs to be designed for maximum outdoor DB temperature, while other equipment needs to be designed to function well in high humidity conditions. Still other systems need to be tested under extreme (high and low) solar irradiance conditions. Some equipment needs to be tested in a number of conditions of combined temperature, humidity and solar conditions. Designers need to feel comfortable that their designs have been tested in a varying number of weather situations in order to carry out responsible engineering design services. What is needed is a methodology, or tool, that enables designers to select customized weather sequences to test performance of their designs. The weather data cannot be derived from existing files that have already been biased to meet other objectives -- e.g., extreme design sequences, TMY2, etc. The customized sequences will have to be derived from raw weather data files available from NOAA and other disseminators of hourly weather data.

The purpose of this research is to develop a generalized tool that permits designers to select user-customizable weather data sequences from available hourly climate data files. The selection methodology would enable designers to select data for estimating both peak and partial load operating conditions of HVAC equipment. Expected procedures for accomplishing this are:

- 1) Identify available, existing sources of weather data and selection procedures. Agencies, such as the USDOE, ASHRAE, NOAA and private companies, such as Square One (UK), and GeoPraxis (USA) should be included in the investigations.
- 2) Establish/evaluate the engineering criteria for what sort of weather sequences will serve the needs of HVAC equipment designers. Evaluate whether available weather data sources contain adequate information to meet the use criteria.
- 3) Develop a procedure for scanning hourly weather data to pick out sequences that represent a variety of conditions to which HVAC equipment will be exposed and expected to operate.
- 4) Develop a software toolkit that enables users to set criteria, scan data files, and extract a customized weather data sequence appropriate to the need.

The research results from the described project could be widely used by all ASHRAE members, with the following benefits:

1. Members and the entire energy engineering design community would continue to look to and depend on ASHRAE to supply reliable data and methods for design and simulation in the building HVAC field.
2. Designers/users of the customized weather product would generate HVAC designs more compatible with their outdoor environment, resulting in more comfort for building occupants and more energy-efficient equipment.
3. ASHRAE members could discover creative ways to utilize available weather data for applications that are as yet undefined in their day-to-day practice. The number of possible uses is unconfined.

Objective:

The objective of this work statement is to develop a generalized tool that permits designers to select user-customizable weather data sequences for use in building design and energy simulations.

References:

ASHRAE, 2001, WYEC2 Software, ASHRAE Final Report, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

ASHRAE, 2000, Weather Data Viewer, WDVVIEW 2.1 – CD, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

ASHRAE, 1998, Design Weather Sequence Viewer, Ver. 2.1, Powerpoint presentation on web site:
http://www.bae.uky.edu/~colliver/Programs/sequence_overview/sld001.htm

Colliver, D.G., R.S. Gates, H. Zhang, and K.T. Priddy. 1998. Sequences of Extreme Temperature and Humidity for Design Calculations (Technical Paper 4105, RP-828). ASHRAE Transactions Vol 104(1):133-144.

Thevenard, D.J. and A.P. Brunger, 2002, The Development of Typical Weather Years for International Locations: Part II, Production (Technical Paper 4596, RP-1015). ASHRAE Trans., Vol 108(2).

**RTAR (RESEARCH TOPIC ACCEPTANCE REQUEST)
TC 4.2 Weather Information**

Title: WYECs for 2025 (2050 and 2080)

Research Category:

Research Classification:

TC Priority:

Estimated cost: (algorithms \$30,000; data generation \$60,000 for 200 sites).

Other interested TCs/TGs:

Possible Co-funding organizations:

Handbook chapters to be affected by the results:

State of the art / background

Scenarios produced by the Intergovernmental Panel on Climate Change (IPCC)¹ show a probable rise of up to 6°C in the Earth's mean surface temperature by 2100. This temperature rise will be associated in some regions with other changes, for example more frequent periods of intense rain, higher mean wind speeds and more frequent storms. These will increase environmental stresses on buildings and structures.

While there is still continuing debate on the origins of the current global warming, it is generally recognized that greenhouse gas emissions from human activities are a principal cause. The use of energy in the built environment accounts for a significant proportion of such emissions – some 40% of emissions from temperate developed countries are attributable to the heating, cooling and lighting of buildings and associated provision of hot water and cooking facilities. A further 5-8% is associated with the production and transport of construction materials. Much research aimed at reducing energy consumption has been carried out in the last 20 years and the Kyoto Agreement commits signatories to national reductions – albeit not by the 60% or so that it is estimated will be required in order to stabilize the global climate.

However, whatever action is taken to stimulate reductions in emissions in response to the Kyoto accord, the global temperature will rise for the foreseeable future and with this rise in temperature will come the associated changes in local climates. Some climate changes may not require immediate change of construction practice – for example those parts of buildings which are regularly replaced or maintained (e.g. paint finishes) may be treated with products that have evolved to meet new requirements. But the cost of replacing or upgrading other parts (e.g. underground drainage) may far outweigh the additional cost of extra capacity at the time of initial installation. Such decisions need to be made in the light of the best available information on future climate scenarios and their implications.

Against this background, the focus of OCCALBE is on *anticipation* and *adaptation* to climate change, so that the built environment will function effectively in the future. However, the network will need to take due note of research directed at *mitigation* of climate change (i.e. reducing emissions) since measures that address one issue may promote or prejudice the achievement of other goals.

¹ IPCC Shanghai meeting (2000) www.ipcc.ch

Advancement of the state of the art / Justification:

With a number of climate change models around the world producing similar results for the same scenarios from the IPCC (Intergovernmental Panel for Climate Change) general climate change results are available. With simulation being increasingly used in the HVAC and building design industry there are only WYECs for historic data. Increasingly clients are becoming interested in how their buildings and plant will perform in future years with possible climate change. This is especially necessary where low energy air conditioning and natural ventilation is used not only in North America but in Europe and temperature climates. Energy, CO2 emissions and pollution are also important factors for designers to consider.

Justification and value to ASHRAE

Although there are still some who are skeptical of climate change actually happening, increasingly organizations, engineers and scientists are accepting the facts presented. ASHRAE members need to be able to respond to these actors and stakeholders who want to consider climate change. This is especially relevant for building and plant designs where the building shape and fabric are used to reduce the AC load as buildings can last for many years and will be affected by possible climate change. Although the AC plant can be renovated and its size increased the building form cannot so easily be changed.

ASHRAE members need to be able to respond to clients interested in climate change. They need the data. This proposal will provide it.

Objective and deliverables

To develop algorithms to produce hourly weather data from climate change model data (often daily or monthly). Such climate change models are the US (any details Dru?) and UK Hadley model.

WYECs can then be produced for 2025 (2050 and 2080 TC 4.2 to decide; GJL suggests 3 years) for x US locations and y worldwide locations corresponding to a limited number of existing ASHRAE weather sites (TC 4.2 to decide how large or small the number and consequent cost).

**RESEARCH TOPIC ACCEPTANCE REQUEST (RTAR)
TC 4.2 Weather Information**

<u>Title:</u>	Improved Database of Earth Temperatures and Municipal Water Supply Temperatures for Use with Building Simulations.
<u>Research Category:</u>	Design and O&M Tools
<u>Research Classification:</u>	Basic and Applied
<u>TC/TC Priority:</u>	New
<u>Estimated Cost:</u>	\$95,000
<u>Other Interested TC/TGs:</u>	TC 4.7, TC 9.6, TC 6.8, TC 6.6
<u>Possible Co-funding Organizations:</u>	NOAA, NWS, USDOE, USEPA
<u>Handbook Chapters to be Affected By Results of this Project:</u>	Chapter 27 Climate Design Information Chapter 31 Geothermal Energy Chapter 48 Service Water Heating

Background/State-of-the-Art:

Whole-building, general purpose, hourly energy simulation programs are used by building designers for calculating peak heating/cooling loads and the annual performance of new buildings. Energy simulation programs are also used for other purposes, including the verification of the savings from retrofits installed in existing buildings, and for calculating the energy impact for building code requirements such as ASHRAE Standard 90.1, and 90.2. Such programs calculate the dynamic heat transfer through roofs, walls, windows and floors, as well as the energy used for heating domestic water, which is used for cooking, cleaning, and bathing activities. In most cases these programs use average weather data, such as TMY, WYEC, TRY or more recently released formats such as TMY2, WYEC2 and TRY2 formats, which have been compiled and extensively studied from many years of data for a given location and contain hourly data for dry-bulb temperature, humidity, solar radiation, wind speed, and other variables.

Surprisingly, such average weather files do not contain average hourly earth temperature data, which is needed for calculating the dynamic heat transfer through surfaces in contact with the earth. Also missing from such weather files are the hourly temperatures of the municipal water supply temperatures, which are needed for calculating the heating required to deliver domestic hot water to the building occupants for use in cooking, washing, clothes washing, etc. To compensate for the missing data, widely used programs such as DOE-2 estimate the earth and municipal water supply temperatures using data and procedures developed by Kusuda in the 1960s for determining the heating and cooling equipment requirements for conditioning atomic bomb shelters (Kusuda and Achenbach 1965). Although these data and procedures have served the HVAC industry well for almost 40 years, they are based on measurements from only 63 stations (and only 28 stations for ground water sources from a 1925 study by Collins), and can be significantly different from measured earth and municipal water supply temperatures.

Justification and Need/Advancement to State-of-the-Art:

To date, no nationwide database of earth temperature data or municipal water supply temperatures has been compiled by ASHRAE and incorporated into the appropriate format for use by building simulation programs.

Historically, programs such as DOE-2 estimate the earth and municipal water supply temperatures using data and procedures developed by Kusuda in the 1960s for determining the heating and cooling equipment requirements for conditioning atomic bomb shelters (Kusuda and Achenbach 1965). Such estimates can be significantly different from measured earth and municipal water supply temperatures.

Hence, the purpose of this research is to develop database of earth temperature data, municipal water supply temperature data, and other relevant data (i.e., soil properties) that can be incorporated into the proper format for use by building energy simulation programs. Accordingly, there are three thrusts to be emphasized:

1. To identify readily available, existing sources of earth temperature, soil characteristics and municipal water supply temperature data, and determine how such data can be reformatted into the proper weather data format for use by building energy simulation programs.
2. Assemble and convert the available data into the proper weather data format for use by building energy simulation programs.
3. Analyze the resultant impact of the use of the new data versus what is currently available.

The procedures outlined in this work statement will result in an ASHRAE publication that can be widely distributed to ASHRAE members.

The project will benefit the following:

- ASHRAE to buttress the credibility of the use of simulation codes based on ASHRAE methods by the energy engineering community.
- Software code developers and users to assess how well simulations account for heat transfer to/from the earth, ground-coupled systems simulations, and energy use for service water heating.
- ASHRAE members as a guide for more effective use of available weather files for computer simulation in their day-to-day practice.

Objective:

The objective of this work statement is to develop an improved Database of Earth Temperatures and Municipal Water Supply Temperatures for Use With Building Simulations.

References:

Collins, W., D. 1925. "Temperature of Water Availability for Industrial use in the United States", U.S. Geophysical Survey Water Supply paper 520-F.

Kusuda, T., Achenbach, P. 1965. "Earth Temperature and Thermal Diffusivity at Selected Stations in the United States", ASHRAE Transactions.

Minutes of the ASHRAE TC 4.2 Handbook Subcommittee Meeting

January 25, 2004, NOON - 3:00PM
Anaheim, CA

The TC 4.2 Handbook meeting was held jointly with the RP-1273, "Update the Climatic Design Conditions in the ASHRAE HOF" PMS meeting.

In Attendance:

Marc Plantico	TC 4.2 Handbook Chair
Dru Crawley	RP-1273 PMS Chair
Chip Barnaby	
Didier Thevenard	Contractor for RP-1273 (Numerical Logics, Inc)
Alex McGowan	Contractor for RP-1273 (Levelton)
Bob Humphries	Contractor for RP-1273 (Levelton)
Joe Huang	
Tom Stoffel	
Larry Degelman	
Gideon Rozen	
Geoff Livermore	
Steve Cornick	
Steve Bruning	
Bill Fleming	Handbook Liaison
Jim Pegues	
Mark Hertel	TC 6.7 Handbook Chair, Solar Energy Utilization

The meeting agenda is attached.

The meeting was called to order at 12:10 PM.

1. Status and Schedule for 2005 Weather Chapter

Plantico reported that he had talked with Mark Owen, ASHRAE Handbook Editor, and Climatic Design Information will be Chapter 28 in the 2005 HOF. ASHRAE is currently working on the 2004 Handbooks so there is no rush to deliver our Chapter before June.

The following schedule for delivering the final tables and text to ASHRAE was agreed upon:

TABLES:	"Final" tables for TC 4.2 & PMS review	March 1, 2004
	PMS Final Table Review Completed	April 15, 2004
	Final tables delivered to ASHRAE	June 15, 2004
TEXT:	New sections/changes submitted to Plantico	March 1, 2004
	Draft "final" text for PMS/Handbook Review	April 1, 2004

PMS/Handbook Final Review Completed
Final Text delivered to ASHRAE

May 15, 2004
June 15, 2004

There was discussion concerning how many pages the weather chapter could be and guidance from Bill Fleming, Handbook Committee Liaison, was to not worry about the size and just provide everything to ASHRAE. [NOTE: ASHRAE has since provided more guidance and has limited the number of printed pages for the weather chapter to what we have in the 2001 HOF (~70 pages). The Handbook CD-ROM may contain data for all stations, even if it is not in the printed chapter.]

2. Outline for New Chapter

Chip Barnaby provided a draft outline for the new weather chapter (see Attachment A).

The following are the action items for completing the weather chapter for the 2005 HOF as agreed to at the Anaheim meeting. Authors/revisers will submit their sections/revisions to Plantico by March 1, 2004.

- 1) **Introduction and Description of Tables - Didier Thevenard** will provide updates to number of stations, data sources, description of tables, calculation of design conditions, etc. based on RP-1273 work.
- 2) **Generation of Design-Day Sequences - Chip Barnaby** will provide a write-up describing this material which was previously in Chapter 29 (Load Calculation Procedures). This section will specify how to take the information from the climatic design weather tables and construct 24-hour profiles suitable for use in building load calculations. He will rework the example using Atlanta and will add a discussion of how to generate a wet bulb profile (1% for all months).
- 3) **Clear Sky Solar Procedures - Chip Barnaby (lead)** will work with **Didier Thevenard, Tom Stoffel, Joe Huang** and **Geoff Levermore** to determine the extent of changes for including material on the clear sky solar procedures currently in Chapters 29 & 30. TC 4.5 (Fenestration) is agreeable to moving this material to the weather chapter but Chip et al will determine if improvements can be made in time for the 2005 edition.
- 4) **Representativeness of Data and Sources of Uncertainty:** Plantico reported that **Bob Morris** agreed to update this section incorporating work from RP-1171 (Sources of Uncertainty in the Calculation of Design Weather Conditions).
- 5) **ASOS Weather Data: Chip Barnaby** will provide a section summarizing RP-1226 (Integration of ASOS Weather Data into Building Energy Calculations).
- 6) **Other Sources of Climatic Information - Marc Plantico** will add a section on the Global Weather Data Source Web Page (RP-1170) and update sources from NCDC. **Tom Stoffel** will provide new/updated sources from NREL. **Bob Morris** will update sources from Environment Canada. **Didier Thevenard** will provide a few sentences for IWEC. Anyone else with additional sources will send them to Plantico.

7) **References:** Everyone will review the references and send changes to Plantico.

Plantico will check with ASHRAE to see who Didier Thevenard can work directly with on formatting issues for the printed tables.

3. RP-1273 Report to PMS (Levelton Engineering/Numerical Logics)

Didier Thevenard presented the RP-1273 status report. The project is on schedule and the “final” tables should be available for review by the end of February. The Weather Data Viewer should be completed by the end of March and the project report and technical paper will be completed by the end of April.

Criteria for calculating design conditions were reviewed and the PMS requested the following changes:

- a) include a year in the calculation of mean and standard deviation of extreme dry bulb if the year is 85% complete rather than 90% (this is to be consistent with other criteria that specify a 85% completeness)
- b) use 8 as the minimum number of years to calculate mean and standard deviation of extreme dry bulb rather than 5 (again to be consistent with other completeness criteria).

Didier reviewed the quality assurance and went through some examples of erroneous station coordinates and values outside expected limits. A summary of stations meeting the station selection criteria (before the changes noted above were implemented) showed that 4060 stations met the criteria. 75 stations that are in the 2001 HOF did not meet the criteria for the 2005 chapter. After the station data are rerun with the new criteria and station moves are accounted for, Didier and Plantico will try to minimize the number of dropouts.

A comparison of 2005 values versus 2001 values showed excellent agreement for most stations for dry-bulb and dew point temperature elements. It was noted that the comparison for prevailing wind direction exhibited large differences but this was to be expected based on different computational methods. The standard deviation of extreme (max) annual dry bulb temperature also showed some larger departures.

The Weather Data Viewer is currently under development but a prototype version was distributed to the PMS on CD-ROM. A new compression algorithm allows all 4000+ stations to fit on one CD. The WD Viewer is 50% complete and should be completed by the end of March. Didier agreed to provide the 5, 10, 20, 30, 50-year mean extreme max temp that Gideon Rozen has requested on the WD Viewer. Gideon felt that the use of the logarithmic formula (eq. 1 in Chapter 27) was cumbersome and engineers were misusing using it.

The meeting was adjourned at 3:00 PM.

Minutes prepared by M. Plantico February 22, 2003

**AGENDA FOR JOINT HANDBOOK/RP-1273 SUBCOMMITTEE MEETING
2004 WINTER MEETING – ANAHEIM, CA
SUNDAY JANUARY 25, 2004 NOON - 3:00 PM**

Anaheim Marriott/Los Angeles Room

1. Status and Schedule for 2005 Weather Chapter - Plantico

New Chapter will be Chapter 28 in 2005 HOF

ASHRAE Scheduled Delivery date March 29, 2004 but due to backlog **early June** OK
(per Mark Owen 1/22/04)

Final review of 2005 Tables - May 2004

Final review of new text - May 2004

2. New Chapter Outline (see below) – Barnaby

3. RP-1273 Report to PMS - Levelton Engineering/Numerical Logics

Issues: Have we improved coverage of data sparse areas?

Have we satisfied needs of Costa Rica, Mexico, Pakistan, etc.?

How many stations will be published in Handbook?

Have “duplicate” stations been eliminated?

Others??

4. Other Business

Attachment A

Weather Chapter Outline

Chip Barnaby, Jan. 16, 2004

Introduction

As now, updated re 1273.

Climatic Design Conditions

As now, updated re 1273 and new tables

Generation of Design-Day Sequences

New section.

- Material from p. 29.16 – 29.17 (including Table 17)
- Addition of wet bulb procedure
- Reference to clear sky solar (Chap. 29 and 30, or as moved)
- Example

Other Sources of Climatic Information

As now, updated.

There is now so much data on-line, we need to provide some links.

References

Updated, include web addresses pointing to data sources

Tables

Revised per 1273.

Issues / questions...

- Where do we stand regarding what goes in printed HOF and what is on CD? How does that get dealt with?
- Where does 1171 work go?
- Where does 1226 work go?
- Other research results?
- General discussion of ASOS and implications?